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Effect of different herbicides on growth and yield of transplanted basmati rice (*Oryza sativa* L.)

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Abstract
Weeds are the cause of serious concern on rice production. Therefore a field experiment was conducted during *kharif* season 2017 to study the effect of different herbicides on growth and yield of transplanted basmati rice at Shri Guru Ram Rai (P.G) Collage Dehradun, (Uttarakhand). The experiment were comprising ten treatments of weed management. The results indicated that chemical methods of weed control significantly reduced the total weed population (m^{-2}) and weed dry weight (gm^{-2}), while increased weed control efficiency effectively over weedy check. The highest number of tillers (m^{-2}) at harvest, filled grains $panicle^{-1}$, unfilled grains $panicle^{-1}$, grain yield (q/ha), biological yield (q/ha) and harvest index (%) were recorded with the application of Pretilachlor @ 750 g a.i./ha over rest of the herbicides in puddled and unpuddled conditions. Besides it had highest B: C ratio under the treatment receiving Pretilachlor @ 750 g a.i./ha in puddled and unpuddled conditions. Thus, application of Pretilachlor @ 750 g a.i./ha proved better to obtained higher yield and also fetches more profit, besides suppressing weed in transplanted basmati rice.

Keywords: Factor productivity, Herbicides, Profitability, Weed dynamics and Yield

Introduction
Scented rice (*Oryza sativa* L.) cultivation is emerging as a new economic pursuit for the paddy growers in some localities of Uttar Pradesh. Being a relatively recent introduction into hilly area, adequate information on the population and weed management aspects of this crop are not locally available. Furthermore, weed competition is severe under scented rice because of early slow growth rates (Chander and Pandey, 2001) [1]

Characterization of critical period of crop weed competition (the period during which the crop is subjected to greatest stress for factors of its growth) is therefore necessary. As already discussed for control of weeds the age-old practices are time consuming and costly. So the only alternative left with us to control weeds is the chemical weed control. The effectiveness of herbicides depends upon the water management of rice fields. Standing water in transplanted rice fields helps to suppress germination and growth of weeds. Therefore, the present study was carried out to investigate yield, factor productivity and profitability as influenced by different herbicides in transplanted basmati rice vis-à-vis sustainability of Basmati rice (Malik *et al*., 2011) [6]. In order to formulate an effective schedule for controlling the weeds in rice crop an understanding of nature and magnitude of competition and their effect on various factors of crop growth becomes an essential pre-requisite. Moreover, unlike other cereals crops, rice suffers more from weed competition. The degree of competition and extend of yield loss very with rice culture. It is maximum in direct seeded rice while minimum in transplanted rice. On an average 15 to 20 percent yield is reduced due to weeds in transplanted rice while 30 to 35 percent in direct seeded rice under puddled condition.

Materials and Methods
A field experiment was conducted during *kharif* 2017 at Shri Guru Ram Rai (P.G) Collage Dehradun, (Uttrakhand). The mean maximum and minimum temperatures of 38^0 to 40^0 and 3.2^0c were recorded in the month of June and January, respectively. The mean annual rainfall during crop period was 971 mm (75-80% of which is received during July to September) and average relative humility varied in between 75 to 88% throughout the year. The experimental field was well drained, sandy loam in texture and slightly alkaline in reaction. It was medium in organic carbon, available nitrogen and available phosphorus but high in available potassium. The experiment was laid out in randomized block design under thrice replication. The ten treatments of weed management in the study included (weedy in unpuddled condition, weed free in unpuddled condition, Pretilachlor @ 750 g a.i. /ha in unpuddled condition, Oxyfluorfen @ 200 g a.i./ha in unpuddled condition, Pyrazosulfuron @ 20 g a.i./ha in unpuddled condition, weedy in puddled condition, weed free in puddled condition, Pretilachlor

@ 750 g a.i. /ha in puddled condition, Oxyfluorfen @ 200 g a.i./ha in puddled condition, Pyrazosulfuron @ 20 g a.i./ha in puddled condition. A uniform dose of 50 kg N, 60 kg P_2O_5 and 40 kg K_2O/ha as basal through urea, single super phosphate and muriate of potash, respectively and rest of the 50 kg N/ha was top dressed at maximum tillering and panicle initiation in two equal splits through urea. Zinc sulphate was applied at 30 days stage through foliar spray @ 0.5 percent solution with two percent urea. Transplanting was done manually as per treatments using two seedlings plant^{-1}. One week after transplanting, gap filling was done from the seedlings of same nursery for maintaining the optimum plant population on 5th July 2012. Uniform irrigation was applied to ensure proper crop establishment. The crop was grown as per recommended package of practices and harvested on 07th November 2012. Observations on the total weed population (m^{-2}) and weed dry weight (gm^{-1}) at 30 DAT, 60 DAT and at harvest, number of tillers (m^{-2}) at harvest, filled grains panicle^{-1}, unfilled grains panicle^{-1}, grain yield (q/ha), biological yield (q/ha) and harvest index (%). The yield was estimated by the produce obtained from net plot area, treatment wise and finally expressed at 14 % moisture. The data obtained were subjected to statistical analysis as outlined by Gomez and Gomez (1984) [4]. The treatment differences were tested by using "F" test and critical differences (at 5 per cent probability).

Results and Discussion

Effect on weed and their efficiency

The data presented in Table 1 revealed tha**t** the different chemicals (Pretilachlor @ 750 g a.i./ha, Oxyflorfen @ 200 g a.i./ha and Pyrazosulfuron @ 20 g a.i./ha) control the total weed population and weed dry weight effectively as compared to unweeded check in both condition puddled and unpuddled but puddled condition has better control performance than unpuddled condition. Significantly the lowest total weed population and weed dry weight recorded under weed free treatment because weed free treatment was kept free of weeds by hand weeding. Highest total weed population and weed dry weight were recorded in unweeded check plots due to un checked growth of weeds which compete for all the resources upto maturity with crop. Pretilachlor @ 750 g a.i./ha proved to be the best treatment among the herbicides. Similar finding was also reported by Malik *et al*. 2011 [6]. Among the herbicides the highest weed control efficiency (80.24%) was found with the application of Pretilachlor @ 750 g a.i./ha followed by Oxyflorfen @ 200 g a.i./ha in puddled condition. Simillar trend was also recorded in unpuddled conditions, while in weed free plots it was 100% in both conditions. Similar observations were also recorded by Chopra and Chopra (2003) [2] and Singh *et al*. (2004) [7].

Effect on number of tillers (m^{-2}), yield attributes and yield

Perusal of data presented in Table 2 disclosed tha**t** maximum number of tillers m^{-2} were recorded under weed free plots at all the stages of crop growth followed by application of pretilachlor @ 750 g a.i./ha due to the less crop weed completion in herbicides treated plots in both conditions puddled and unpuddled. Similar results were also reported by Malik *et al*. (2011) [6]. Moreover, filled grains/panicle and unfilled grains/panicle, differed significantly due to various weed management practices. The filled grains/panicle and unfilled grains/panicle were also boost up significantly when the crop was treated with Pretilachlor @ 750 g/ha as compared to oxyflorfen @ 200 g./ha and pyrazosulfuron @ 20 g a.i./ha in both condition puddled and unpuddled. Similar results were also reported by Kathirvelam and Vaiyapuri (2004) [5]. Due to reduced crop-weed competition and better sink capacity increase in the sink capacity of crop was expressed in terms of, filled and unfilled grains. The yield attributes are decided by genetic makeup of the crop and variety, but the agronomic manipulation also affects them to a great extent. The reproductive growth depends on vegetative growth of plant. More vegetative growth increases the photosynthetic area and supply of photosynthates toward sink which decided the yield attributes and ultimately the yield. The higher values of yield attributes may probably due to increased synthesis and translocation of metabolites for the panicle development and grains formation. Besides, thousand grains weight was also maintained because of high mobilization of photosynthates from source to sink, essential for protein synthesis and carbon assimilation. Similar findings were also reported by Subramanian *et al*. (2006) [8] and Yadav *et al.* (2008) [10].

A cursory glance at the data presented in Table 2 reveals that the maximum grain yield (49.99 q/ha) and biological yield (122.9 q/ha) was observed in weed free plots and it was 50.34% and 51.8 % higher than weedy plots in puddled condition whereas in unpuddled condition the maximum grain yield (44.65 q/ha) and biological yield (112.86 q/ha) was observed in weed free plots and it was 47.79% and 49.0% higher than weedy plots. Grain yield recorded in weed free plots was found *at par* with the grain yield recorded in Pretilachlor @ 750 g a.i./ha treated plots. This significant increase in grain yield of rice over weedy check was due to reduced crop weed competition and better sinks capacity brought about by controlling the weeds. Such effects of weed management practices on attributes have also been reported by Dubey *et al.* (2005) [3] and Walia *et al*. (2008) [9]. Furthermore, Harvest index is the ratio of grain and biological yield. From the Table 2 it is clear that harvest index of rice crop was significantly influenced by various herbicidal treatments. The highest harvest index (41.03%) was recorded with the application of Pretilachlor @ 750 g a.i./ha followed by weed free (40.66%) and oxyflorfen @ 200 g a.i./ha (40.56%) over weedy check in puddled condition. This significant increase in harvest index of rice over weedy check was due to reduced crop-weed competition, better sink development and more ability of the plant to convert the dry matter into grain yield brought about by controlling the weeds.

Economics

The unanalyzed data presented in Figure 1 revealed that weed management practices had highest value of B: C ratio under Pretilachlor @ 750 g a.i./ha due to higher grain and straw yield production under this treatment in puddled and unpuddled conditions.

Table 1: Total weeds (m^{-2}), weed dry weight (gm^{-2}) at different stages of crop growth and weed control efficiency (at harvest) as influenced by various treatments

Treatments	Total weeds (m^{-2})			Weed dry weight (gm^{-2})			WCE (%)
	30 DAT	60 DAT	At harvest	30 DAT	60 DAT	At harvest	
Weedy in unpuddled condition	16.57 (264.00)	16.93 (286.33)	16.81 (271.33)	7.75 (55.66)	12.05 (144.67)	13.22 (175.33)	0.00
Weedy free in unpuddled condition	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	100.00
Pretilachlor @ 750 g ai/hain unpuddled	6.38 (40.33)	7.26 (49.99)	6.76 (45.33)	3.75 (13.50)	5.48 (29.30)	6.48 (40.20)	77.07
Oxyfluorfen @ 200 g ai/ha in unpuddled	7.32 (52.33)	8.13 (65.66)	7.62 (57.66)	4.33 (18.12)	6.80 (45.66)	7.71 (58.68)	66.53
Pyrazosulfuron @ 20 g ai/ha in unpuddled	8.26 (65.33)	9.10 (82.32)	8.61 (74.66)	4.96 (24.16)	7.80 (61.41)	8.39 (69.80)	60.18
Weedy in puddled condition	14.88 (221.00)	15.20 (230.66)	14.89 (221.33)	7.54 (52.03)	11.76 (137.83)	13.66 (170.10)	0.00
Weed free puddled conditions	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	100.00
Pretilachlore @ 750 g ai /ha in puddled	6.07 (36.33)	6.79 (45.66)	6.23 (38.33)	3.46 (11.36)	5.01 (24.50)	5.84 (33.60)	80.26
Oxyfluorfen @ 200 g ai/ha in puddled	6.76 (45.66)	7.60 (57.33)	7.15 (50.66)	4.11 (16.33)	7.40 (40.39)	7.01 (48.66)	71.62
Pyrazosulfuron @ 20 gai/ha in puddled	7.47 (55.33)	8.17 (66.33)	7.52 (59.33)	4.48 (19.66)	7.11 (49.50)	7.99 (62.88)	63.18
SEm±	0.12	0.14	0.11	0.05	0.06	0.15	1.43
CD(P=0.05)	0.36	0.39	0.33	0.15	0.17	0.47	4.28

Values are square root (X + 0.5) transformed and the actual are given in parenthesis

Table 2: Yield attributes and yield as influenced by various treatments

Treatments	Number of tillers (m^{-2})	Filled grains $panicle^{-1}$	Unfilled grains $panicle^{-1}$	Grain yield (q/ha)	Biological yield (q/ha)	Harvest index (%)
Weedy in unpuddled condition	269	107	35	31.21	75.66	39.92
Weedy free in unpuddled condition	320	132	19	44.78	112.21	40.58
Pretilachlor @ 750 g ai/hain unpuddled	315	126	20	41.76	109.54	40.31
Oxyfluorfen @ 200 g ai/ha in unpuddled	310	123	21	40.51	105.00	40.94
Pyrazosulfuron @ 20 g ai/ha in unpuddled	305	122	22	38.66	100.54	39.18
Weedy in puddled condition	270	108	34	33.25	86.01	38.99
Weed free puddled conditions	321	132	18	50.00	122.9	40.76
Pretilachlore @ 750 g ai /ha in puddled	317	129	19	48.81	119.06	41.13
Oxyfluorfen @ 200 g ai/ha in puddled	313	124	20	46.05	113.44	40.56
Pyrazosulfuron @ 20 gai/ha in puddled	306	123	21	43.59	109.25	39.69
SEm±	2.2	1.9	0.9	1.28	2.98	0.39
CD(P=0.05)	7.7	5.9	2.8	3.89	8.9	1.20

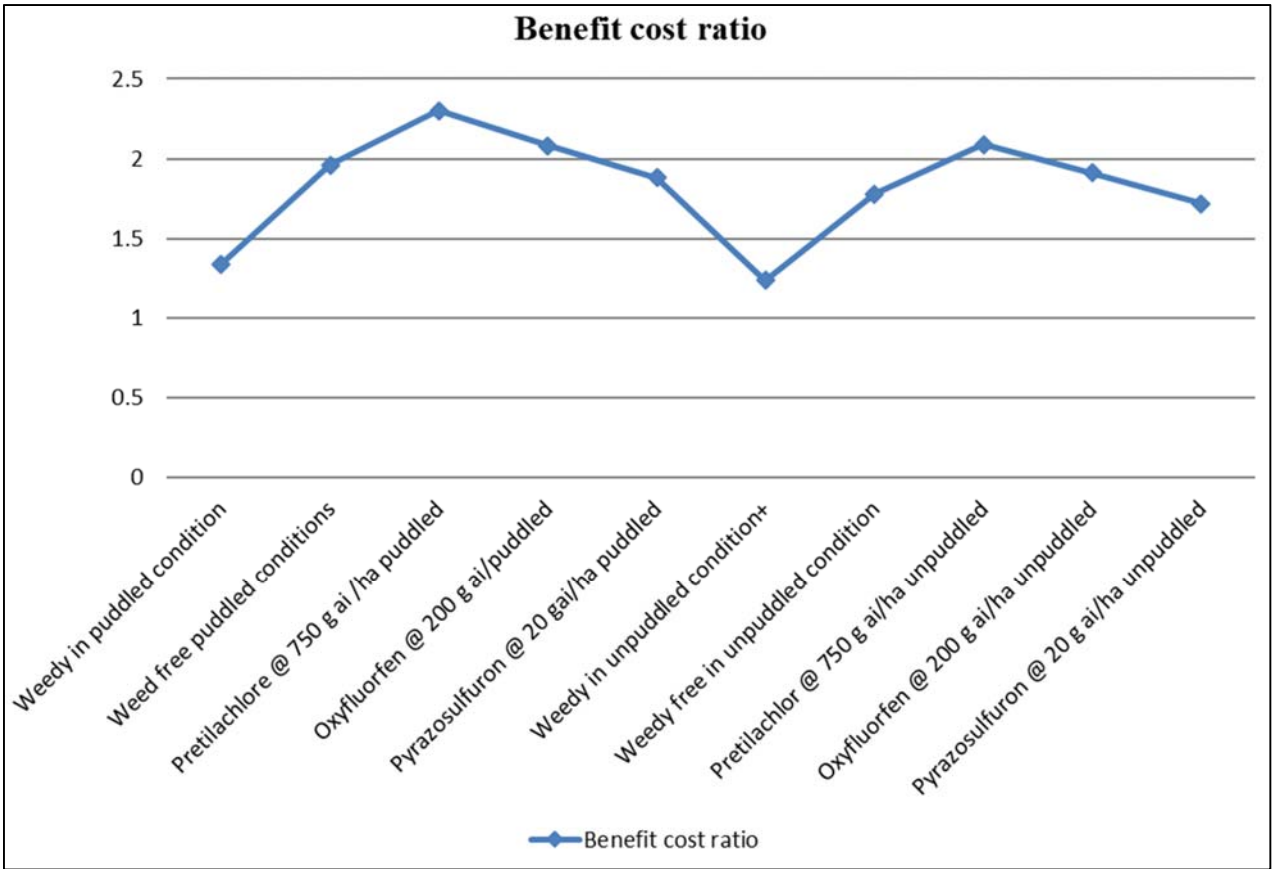

Fig 1: Benefit Cost ratio as influenced by various treatments

Conclusion

Above findings suggest that the application of Pretilachlor @ 750 g a.i./ha proved better to obtained higher yield and also fetches more profit, besides suppressing weed in transplanted basmati rice in puddled and unpuddled conditions over all other herbicidal treatments due to its broad spectrum nature of controlling weeds in the dehradun Uttarakhand.

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